Energy, Machines, and Motion Lesson 21: The Motion on a Roller Coaster

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**Abstract**

Energy, Machines and Motion Lesson 21: The Motion on a Roller Coaster was designed to determine the locations on a roller coaster in which speed varies. Secondly, the experimenter was to determine at which point on the roller coaster the car traveled fastest. It was determined that the roller coaster car traveled fastest in the section in which height did not change. Each section of the roller coaster had a speed that varied. The initial experimental hypothesis was that the speeds would vary, but that the bottom of the first hill would be the location in which the car would travel fastest. This hypothesis was not supported by the data.

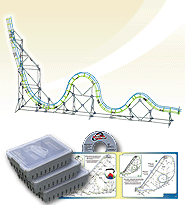
**Introduction:**

This lab investigated the locations along a roller coaster track in which speed attained its maximum value. The lab was based around three experimental questions: (1) What energy transformations take place along a roller coaster track? (2) How does the speed of a roller coaster change at different positions along the track? (3) Where along a roller coaster track does a car travel the fastest?

Based on observations of roller coasters it can be determined that a roller coaster reaches its maximum level of potential energy at the top of the first hill. Each time the car travels down a hill, the amount of potential energy is decreased and converted into kinetic energy. This kinetic energy is then reconverted into potential energy at the top of each subsequent hill. At the bottom of the first hill, the roller coaster will attain its maximum speed due to it having its maximum amount of kinetic energy. The speed of the roller coaster car will change with each energy conversion.

**Materials and Methods:**

* EMM Roller Coaster kit made by K’Nex
* Meter Stick
* Timer



**Experimental Procedure:**

The experiment began with the construction of the roller coaster kit. Then, intervals were marked at follows: from the top of the first hill to the bottom of the first hill was labeled as interval A, from the bottom of the first hill to the top of the second hill was labeled B, from the top of the second hill to the bottom of the second hill was labeled C, and the final interval was the flat section of the track following the final hill and labeled D. The length of each interval was measured and recorded into Table 1. The time needed to travel each interval was measured three times and then averaged to ensure accuracy. Upon measuring time and distance, the speed within each interval was calculated.

**Results:**

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| --- | --- | --- | --- | --- | --- | --- |
| **Table 1: The Speed of the Roller Coaster Car Along Multiple Intervals** | | | | | | |
| Intervals | Distance (m) | Time (s) | | | | Speed (m/s) |
| Trial 1 | Trial 2 | Trial 3 | Average Time |
| A | 0.88 | 0.97 | 1.6 | 0.97 | 1.18 | 0.75 |
| B | 0.73 | 0.41 | 0.56 | 0.69 | 0.55 | 1.32 |
| C | 0.78 | 0.94 | 0.53 | 0.56 | 0.67 | 1.16 |
| D | 0.84 | 0.65 | 0.42 | 0.47 | 0.51 | 1.65 |

The car came nearly to a stop as it approached the top of the second hill. If the car was pushed too hard, the car would derail and cause a miscalculated time. Each time the car was tested, a different amount of force was used to push the car.

**Conclusions:**

Upon collection of the data, it can be determined that the fastest segment on the track was the flat segment following the final hill. This is contrary to the hypothesis. It was hypothesized that the fastest segment would be at the bottom of the first hill. AS predicted, the speed of the roller coaster car did change with each interval traveled. Also, it can be determined that based on visual observations, the car did convert energy from potential to kinetic as it moved along the track.

One major source of error was that with each push of the car, the force applied to initiate the motion varied. This could explain some of the differences in the times in each trial. Also, some of the track sections were not fastened correctly or cam disconnected during the experiment. This caused some of the distance measurements to be innacurate.

If the force used to push the car were more consistent, then the results would be more uniform. Also, by using a flexible measuring tape, one would be able to collect more accurate distance measurements.

Based on the data collected, it is possible to say that the purpose of the lab was achieved as can be determined by the data in Table 1. As can be seen in the final column of Table 1, the speed did change along each interval and that the final interval produced the highest value for speed.